A

PROBATIONARY
SURGICAL ESSAY,
ON
GANGRENE,

SUBMITTED,

BY AUTHORITY OF THE PRESIDENT AND HIS COUNCIL,

TO THE EXAMINATION OF THE

Royal College of Surgeons of Edinburgh,

WHEN CANDIDATE

FOR ADMISSION INTO THEIR CORPORATION,

IN CONFORMITY

TO THEIR REGULATIONS RESPECTING THE ADMISSION

OF

ORDINARY MEMBERS:

By HINTON SPALDING, M.D.

EXTRAORDINARY MEMBER OF THE ROYAL MEDICAL AND PHYSICAL SOCIETIES OF EDINBURGH.

> " O sight
> " Of terror, foul and ugly to behold,
> " Horrid to think, how horrible to feel."

JULY 1812.

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1812.

TO

JOHN ABERNETHY, Esq. F.R.S., &c.

Dear Sir,

I seize the first opportunity of avowing the obligations which I owe you for professional instruction and domestic kindness; but I shall forbear indulging in this theme, as I am aware that, to you, there is nothing more unwelcome than thanks for benefits received—no subject more irksome than your own praise. I am,

Dear Sir,

In gratitude,

Your Friend and quondam Pupil,

HINTON SPALDING.

58, George Street,
July 7th, 1812.

ESSAY

ON

GANGRENE.

In the following Essay, I shall confine my observations to Gangrene, as it occurs in the external soft parts of the body, under which circumstances, it comes directly within the province of Surgery.

I.

DEFINITION.

Gangrene is the term applied to a part, in which the vital principle has become extinct. It, however, creates, in the mind of a surgeon, the complex idea of the actions induced in the circumjacent living parts, and the changes which succeed in the mortified part, as a portion of dead animal matter—to all the laws of which, it has now become subject.

II.

HISTORY OF GANGRENE.

1. I shall not, in compliance with custom, divide this disease into two stages, assigning to one, the name of Gangrene, to the other, that of Sphacelus; the former denoting its incipient, the latter, its perfected stage.

The terms Gangrene, Sphacelus, and Mortification, I may employ indiscriminately.

2. Gangrene is generally preceded by changes in the part, and its vicinity, which may be accounted presages of its approach.

When it is threatened in a limb highly inflamed, in cases of Compound Fracture, or other accidents, the cuticle is, in the aged especially, often raised into blisters, containing a bloody serum [*]; and this occurrence marks the commencement of Gangraena senilis [†].

Mr Hunter mentions reddish streaks, which commonly run towards the centre of circulation, but not always in this direction, as an omen of approaching Gangrene.

When a part is about to fall into Sphacelus, the bright red passes into a dark purple colour, and this gradually assumes a deeper tint, until it becomes completely black, denoting death. In granulations, on the contrary, a pale hue is the unhealthy sign; and when of this colour, they are apt to pass into a slough. Such granulations die from defect of nourishment, which is a cause widely different from that which occasions death, when it succeeds in parts inflamed. When a part is about to die from being frost-bitten, it is deprived of colour; and this precursor of death is well understood, by the inhabitants of high latitudes.

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[*] Vide Mr Hunter on the blood, &c. p. 274.

[†] Pott's Works. Maggius de scloppetonum et bombardarum vulnerum curatione.

3. Besides the external evidence of change in colour, there is an internal indication of death given, by the loss of sensation in the diseased part, which, at the same time, loses its natural temperature, and soon emits that odour, which marks the decomposition of animal matter—an infallible token of Gangrene having taken place.

4. Sloughing is attended with more or less pain, according to the nature of the case. In Gangrene from frost, I have known it excruciating. We are told by Franck, that in Gangraena senilis the pain is more severe, than in any other case of mortification*.

Does the pain correspond in degree, with the rapid or tardy progress of the disease? With scrofulous ulceration, there is generally little or no pain; but when its progress is rapid, the pain is considerable.

5, Inflammation, accompanying the rejection of a dead part, is in general very gentle, and amounts only to that degree, which is necessary for mild ulceration; so that, compared with phlegmon of equal extent, the inflammation and consequent pain are inconsiderable; for, in the latter disease, the inflammation is not only more violent, but, previously to the occurrence of the relaxing process, the surrounding healthy parts produce a degree of tension, which greatly augments the pain.

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* Franck Delect. opusc. medic. Vol. X. p. 283.

In mortification of the foot or leg, from frost, the pain is certainly great; but this case differs from sloughing in an ulcer, and from that, caused by the effusion of pus or urine in cellular membrane; because the contiguous sound parts have been injured, as well as those which have been killed, and they take on an inflammation more violent than that which is required, merely for the separation of the dead part. "In many bruises we also have inflam-
"mations, quick and violent, even where
"death has been produced in a part; but
"then death does not take place in all the
"hurt parts, as in gun-shot wounds, such as

“ those attended with fractured bones, in
“ which the surrounding parts were only hurt
“ so far as to bring on irritation and not
“ death *.”

When a portion of the body has lost the living principle, it becomes extraneous, and, accordingly, imparts that irritation which produces the actions necessary for its elimination. Absorption, which Mr Hunter has called progressive, is necessary to conduct foreign substances to the surface, when they are imbedded in the body; and the ulcerative absorption is consecutive upon it, when they have reached the skin; but the absorption which effects the separation of living, from dead parts, is, from its commencement, accompanied with ulceration; because a naked surface is in this case its consequence, and ulceration is employed to perfect the cure. This stage of Gangrene, therefore, forms a variety of the phenomenon exhibited by a foreign substance, about to be ejected from the body.

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* Hunter, loco citato, p. 256.

7. Sloughing always begins at the external edge, where the dead is in contact with the living part*; and a line of demarcation is speedily effected, which points out the extent of the disease.

8. Previously, however, to any attempt at separation, a very remarkable change takes place in the blood vessels; both arteries and veins becoming impacted by a firm coagulum, to a great extent. Mr Hunter, in a case of mortification of the foot and leg, found even the iliac artery filled with a coagulum †.

I cannot offer an explanation of this phenomenon—I am unwilling to resort to a final cause—nor can I lend myself to the hypothetical speculations of the author, who attributes the coagulation of the blood, in such cases, to a disposition imparted to it by the blood vessels‡; and who, in another part of his work,

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[*] Vide Hunter, loco citato, p. 448.

[†] Vide Hunter, loco citato, p. 23. The same observation is recorded in the Traité de Gangrene, par Quesnay, p. 402.

[‡] Hunter, loco citato, p. 312.

employs the same phenomenon to support his peculiar opinions, ascribing the coagulation to a principle, originating in the blood itself. "For this (coagulation), however, it (the "blood) requires rest, either by extravasation, "or by being retained in the vessels till the "utility of circulating is lost; or till it can "answer some good purpose, by its coagula-"tion, as in mortification*.

We must view this coagulation as a wise provision of nature, to avert the danger of haemorrhage from the larger vessels previously to their division, by the sloughing process.

9. The separation of the dead from the living parts advances centrad, from the edge, through cellular substance, muscle, and tendon; and in the more severe cases, from frost, the bone, even, would be separated in like manner, if the surgeon did not interfere, to spare nature this most tedious step of the process.

10. After the living has thrown off the dead part, the surface remains irregular, and in the

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* Hunter, loco citato, p. 86.

state of simple ulcer; for, when a portion of a limb is lost, the disease is observed to have, at one time, extended farther on the surface, at another, farther among the deep seated parts*. This may be deemed the natural process adopted for the cure of Gangrene; but the powers of the system may sink ere the task is performed. If such a termination is threatened, the constitution falls into a state of febrile irritation, attended by all the symptoms of reaction, which accompany a last effort to overcome a morbific power.

11. Some structures suffer death more speedily than others. Newly formed parts are easily killed. Cellular substance is less tenacious of life than skin, and more tardily throws off a dead portion. Tendons slough more slowly than muscles; and bones are extremely tardy in going through the process of exfoliation.

12. When Gangrene has once begun, it seems to prey upon the neighbouring parts, and

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* Pott, Vol. I. p. 452. Quesnay Traité de Gangrène, p. 181.

spreads from point to point. Among surgeons, this has universally given rise to an idea, that the disease is an active agent, and, of itself, spreads by contaminating and killing the neighbouring sound parts. In uniformity with the view which I have taken of the subject, I hold this opinion to be erroneous; and I conceive, that the dead portion is wholly harmless, and totally inactive, except by the irritation which it imparts. I conceive that death ensues in the conterminous living parts, in some cases, from inflammation occasioned by the injury, which had at the same time killed one, and irritated another portion; and that, in other cases, it arises out of the inflammation excited by the dead, in the weak living parts—When one part has died from debility, the adjoining is easily overcome, even by the gentle inflammation which the dead excites.

III.

CAUSES.

1. By a law of animal life, every action of the body is followed by a state, approaching to exhaustion; and this state generally corres-

ponds, in degree, with the force of the previous excitement. As with the whole, so with its parts: thus, if the blood vessels of a part have been over-excited, they afterwards fall into a state of inaction or debility; and this state of debility will be in the direct ratio of the previous excitement.

If the excitement has observed that limit, beyond which it cannot with safety be carried, the part will gradually recover its due share of living power; but if the excitement has overstepped that boundary, the living principle becomes irrecoverably extinct—the part becomes dead or mortified.

2. There is, however, to be taken in conjunction with this, another very important circumstance, which modifies the general law, as it relates to the subject now under consideration. That the blood is the medium by which nourishment is conveyed throughout the body, and the principal agent in that function, no person will deny; while the necessity of its presence, for the health and support of every part, is equally obvious. The heart is the

grand centre, from which this vital fluid emanates, and to which it returns: Whatever, therefore, obstructs its distribution, cuts off the necessary supply of nourishment, from the parts beyond the point of obstruction; and this will ultimately terminate in their death.

By the pulse, as indicating the strength of circulation, we judge of the state of the system; when the body is debilitated, the circulation becomes languid; and this is more or less obvious, as we recede from, or approach, the heart. In this state of the body, the living powers of the parts most remote from the centre of circulation are easily exhausted, and speedily yield to any injury inflicted on them; so that a slight excitement will carry them beyond the boundary, from which they may be restored to health: Hence the danger of applying blisters, and making punctures in dropsical limbs; and the fatal effects of slight injuries, in the paralytic and aged.

3. From what has been mentioned, it appears, that those circumstances which diminish the living power of the whole, or a part, are

predisposing causes; and that those agents, which destroy the living power of a part, are exciting causes of Gangrene.

Among the former class we may enumerate all diseases which produce marked debility; especially Putrid Fever, Paralysis, Dropsy, and Scurvy; to which I shall add, Poor diet, Habitual Drunkenness, and Old age.

Among the latter we may mention Pressure, so applied as to obstruct circulation; Deep lacerated Wounds, Ossification, Priapism, Contagion, Inflammation, External violence, Caloric, Extreme and long continued Abstraction of the Natural Heat of a part, and Old age.

IV.

PREDISPOSING CAUSES.

1. I have already stated, that the dangerous consequences, following the action of blisters, and other causes exciting inflammation, arise out of the debilitated state of the system in general, and of the lower extremities in particular, induced by the diseases above mentioned.

In the same manner, we must explain the operation of the other debilitating causes, the efficiency of which is so obvious, that it would be superfluous to dwell on this branch of the subject.

Carbuncle.

2. Carbuncle, which makes its appearance most frequently during the course of Putrid Fever, is a species of tumor, distinct from Phlegmon. Mr Hunter informs us, that it is accompanied by an inflammation, sharing the characters of the phlegmonous and erysipelatous; the base is more extended; and the matter more diffused through the cellular substance, than in the true Phlegmon; but there are, nevertheless, adhesions which bound the abscess, and prevent that universal diffusion of the matter, through the cellular membrane, which is the consequence of the true erysipelatous suppuration. Mr Hunter also states, that Carbuncle more rarely appears on the extremities, than on the trunk of the body: I have, therefore, thought proper to introduce these observations, as this fact seems to oppose the view which I have taken of the subject. But I may remark, that Mr Hunter probably alludes to this dis-

ease, as occurring in men who have lived voluptuously; for he does not mention Carbuncle accompanying Putrid Fever or Plague, as the particular subject of his observations; and I may mention, that from among the cases related in the appendix to Mr Russell's work on the Plague, the greater number may be selected, in which Carbuncle appeared on the extremities. Boils are not unusual in men, who, apparently, enjoy good health, and these most frequently shew themselves on the trunk and about the buttocks. Carbuncle may present itself in the same parts; but it is probable, that the debility modifies the inflammation, so that, what, in a more healthy constitution, would have produced Phlegmon, here excites the sloughing Carbuncle.

V.

EXCITING CAUSES.

The exciting causes of Gangrene may be divided, into those which directly produce death in a part; and those which indirectly induce the same effect, by previous excitement, and consequent exhaustion.

To the former head are referrible, Presssure, so applied as to interrupt circulation, Deep lacerated wounds, Ossification of a principal artery, Priapism, Contagion, and Old age.

To the latter we refer Inflammation.

External violence, Caloric, and Extreme and long continued Abstraction of the Natural Heat of a part, may produce Gangrene, by a direct, or indirect, agency.

VI.

PRESSURE.

1. Pressure made by a ligature, or any other means, causes Gangrene, by cutting off from a part its supply of blood.

" Interruption to circulation produces death " (says Mr Hunter); and it is not clear to me, " whether the blood dies sooner without the " body, or the body without the blood[*]."

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[*] Hunter, loco citato, p. 85.

Gangrene in the bed-rid.

2. Perhaps it is doubtful whether the sloughing of the soft parts over the sacrum, and in the loins of bed-rid patients, arises from the circulation being interrupted, by the pressure of the body against the bed; or from the agency of absorption, excited by the same cause; or from the combined effect of both.

It is easily to be perceived, that under such circumstances, slight will be the pressure required to interrupt the languid circulation; and this pressure being long continued, will be sufficient to account for the death of the oppressed parts. But the influence of absorption is too powerful to be overlooked. By removing the soft parts, it will augment the effect of pressure on the blood vessels.

VII.

LACERATED WOUNDS.

Lacerated wounds must go through the suppurative process, to a greater or less extent, before they heal; and if they are so extensive, that a great portion of the limb is involved, the supply of blood is cut off from the more distant part, and Gangrene takes place, before circulation can be restored by the healing process. Such would be the state of a limb, which has suffered a severe lacerated wound, or compound fracture, if the consequence were not averted by the knife.

VIII.

OSSIFICATION.

1. I can say little of Gangrene, when it originates from Ossification of a principal artery.

The knowledge which we now possess, of the powers of nature in providing for the nourishment of a part, which has been deprived of its direct supply of blood, by the enlargement of collateral channels, would lead us to conclude, that no part will die from this cause, in a constitution otherwise healthy and vigorous; and observation * and experiment enable us to say that the abdominal aorta, even, may be obstructed, and the lower part of the body still receive a sufficient supply of blood,

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* Scarpa on Aneurism, translated by Mr Wishart.

from the enlarged inosculations of the internal mammary, and epigastric, and other channels.

2. In the aged, the powers of life are easily disturbed, and little adequate to repair injuries. Ossification is more frequent at this period ; and Gangrene has, perhaps, been more frequently observed : yet it may be alleged that, in such cases, Gangrene and Ossification are equally concomitants of general debility.

IX.

PRIAPISM.

1. Priapism is a rare cause of Gangrene. I have, however, seen an instance of it from this cause. The penis becomes erected, and continues in that state, until it is attacked by Gangrene, and drops off by the root. Such was the history and result of the case alluded to. When this termination of Priapism is threatened, the blood becomes coagulated in the cells, previously to mortification *. Priapism indu-

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* Hunter, loco citato, p. 23.

ces Gangrene, by opposing a permanent obstruction to the return of the blood from the part; but so little do we know, either of the change produced in erection, or of its c~~o~~au~~r~~se, that both the duration constituting the disease, and the state inducing Gangrene, must remain unexplained.

3. The cells of the penis, like cellular membrane in general, soon lose the small share of vitality, with which they are endowed; as is frequenty and amply verified, by the destruction from sloughing, which occurs in the penis—the consequence of inflammation from lues, and effusion of urine; and the death of the part speedily succeeds to the interruption of its circulation, in Priapism.

X.

CONTAGION.

1. A distinct account of Gangrene, produced by contagion, claims a place, in a very modern aera of surgery.

But from the improvements in natural knowledge, which have advanced, and are still advancing, with rapid progress, it is to be presumed, that while Gangrene from this cause will be of more rare occurrence, our means of setting bounds to its ravages will become more extended, and our practice, when it does occur, more successful.

2. The disease from this cause has the usual characters of Gangrene, of the most malignant form, combined with a few peculiarities, by which it is distinguished; and from the situation in which it is endemic, it has obtained the name of Hospital Gangrene. The peculiarities of Hospital Gangrene are, the cause from which it takes its origin, and under which I have classed it, namely contagion ; its attacking sores of the most healthy complexion ; its being accompanied by violent constitutional symptoms ; and endemic in hospitals and similar situations.

3. Absolute contact is not necessary to produce the baneful effects of this contagion, as is

verified by Dussaussoy*; while its ready agency, when so applied, is also made out on the same testimony, and that of Brunninghausen, who relates, that a person employed to wash the bandages which were taken from sores of this character, had a pimple on the hand, which soon became the seat of the same species of disease†.

4. Gangrene from contagion arises in hospitals; and has been remarked to occur in those of bad construction, or under circumstances which prevented that attention to ventilation, which is necessary for the health of the patients. It has, accordingly, been observed to occur in winter, when the windows were kept close to retain heat, or to exclude rain and moisture.

We are not ignorant of the account of this sore, given in Dr Trotter's Medicina Nautica, particularly in Mr Moffat's report, where the return of cold weather in October is mentioned, as having produced a favourable change in the history of the contagion; but in ascribing an opposite influence to cold weather, we view it as an indirect effect—an effect produced by interruption to free ventilation.

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* Dussaussoy Dissertation sur la Gangrène des Hospitaux.

† Bibliotheque Germanique, Vol. V.

5. Very violent constitutional symptoms generally accompany Gangrene, produced by contagion; such as all the symptoms of incipient fever, with vomiting incessant until death: and this may perhaps entitle us to ask, whether the local disease is the cause, or consequence, of the constitutional affection. The most healthy sores fall into a state of sloughing, in the course of a few hours; which circumstance is anomalous in the history of Gangrene.

6. It has also been remarked, that the more extensive the surface of the sore is, the more liable it is to become the seat of contagious Gangrene; but the smallest puncture forms a nidus for the contagion: nay it has even shewn itself, like Carbuncle, without being invited by

any local injury[*], which also favours the supposition of its being a constitutional affection.

7. It has been asserted, that sores of a specific nature resist the influence of this contagion. On the authority of Dr Rollo, we may particularize the venereal, variolous, and scrofulous[†]; and may mention, that Dussaussoy applied the virus of a sore, affected with Hospital Gangrene, to a cancerous ulcer; but without inducing the disease, until he had wounded it by a pair of forceps[‡]. Dr Johnston states that he has seen suppurated venereal bubos become the seat of this contagion; and gives us Mr Russell's authority, that the cancerous ulcer is not secure from its influence[||]. We are, therefore, inclined to believe, that the sore of Hospital Gangrene has nothing specific in its nature; and that this disease may, therefore, occupy sores of a specific character, without forming

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[*] Trotter's Medicina nautica, Vol. II. fol. 178.

[†] Rollo on Diabetes, appendix 2d Edit.

[‡] Dussaussoy Observations et Dissertation sur la Gangrene des Hospitaux.

[||] Dissert. Med. Inaug. De Gangraena nosocomiali. A. D. 1805.

an exception to the celebrated aphorism of Mr Hunter, respecting specific actions.

XI.

OLD AGE.

1. Old age exhibits a singular and interesting phenomenon, constituting a species of the disease under consideration, which has been denominated Gangraena Senilis.

Without injury inflicted, the extremity of a limb loses the small share of vitality which it possesses, and in it " life destroys itself:" a black spot appears on the extreme point of a toe or finger, which increases in size, with greater or less rapidity; and Gangrene spreading upwards, the foot and ankle are affected in succession, till the whole limb is gradually destroyed. The member seems to have overlived the power of nature to support it, and must, therefore, yield to " mortality its sen- " tence," even to that point where nature can still supply it with vitality. The disease having run this course, the patient's health is restored:

nay, cases are recorded, in which he has passed, even into a state of obesity *. But this is not always the course of Gangrene from old age: for indeed it more frequently happens, that the enfeebled powers of life are incompetent to the task of bringing forth those actions which are necessary to check the encroaching disease, and are compelled to yield to their adversary.

This species is distinct from Gangrene produced in old men, by an injury offered to a part; because it arises independently of an external cause, and the death of the part is produced directly. In the latter case, old age merely produces a state of debility, favourable to Gangrene.

2. There are varieties of this species of gangrene, so distinct, as to require its subdivision. I shall, therefore, enumerate three forms, as varieties of Gangraena senilis. On each of these, I am little anxious to impose a name;

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* Quesnay Traité de la Gangrène, p. 414.

for the sake of perspicuity, however, I shall denominate them Gangraena senilis humida, cornea, et ephemera.

Some authors have founded a general division of Gangrene, on the moist, and dry state of the mortified part; but these circumstances are equivocal, and certainly too partial to be applied to this purpose. They present, however, a fit ground, on which to constitute a subdivision of the species, Gangraena senilis, into the two varieties, Gangraena senilis humida, et cornea.

The remaining variety, Gangraena senilis ephemera, is distinguished by the extreme violence of the constitutional symptoms, and the rapidity of its fatal issue, which is altogether unlooked for, if we regard only the local affection. My attention was called to it by my friend, Dr James Sanders of Edinburgh. I leave it to the experienced to determine, whether or not I am warranted to consider it as a distinct variety.

Gangræna senilis humida.

3. The history of Gangraena senilis humida corresponds with the general history of Gangrene, and the particular history of the species.

It attacks men who have lived voluptuously, and whose constitution is not *apparently* exhausted. The symptoms are varied, but the parts always retain a degree of moisture, sufficient to favour spontaneous decomposition. This is the disease described by Mr Pott; and although I cannot collect from his works, whether or not he was acquainted with the others, he has given us an excellent description of this variety.

To him we are indebted for a mode of treatment, which, though not universally, has, however, been often found successful. I may therefore refer to his works, for an accurate account of the disease. The treatment, I shall consider, when I speak of the cure of Gangrene in general.

Mr Pott observes, that " It frequently hap-
" pens to persons advanced in life, but is by no

" means peculiar to old age *." Old age, however, is a relative term; for we see men younger in constitution, at the age of seventy years, than others at fifty; and this difference may be found, in every degree, corresponding with the course of life, and innate strength of the constitution. May we therefore be allowed to say, with Mr Hunter, that when Gangrene takes place in the young, " It is in the " young, where great debility has been pro" duced from disease †," dissipation, or other causes.

Gangrena senilis cornea.

Gangraena senilis cornea, like the variety of which I have just spoken, partakes of the generic and specific characters of the disease. Its attack is, in some cases, slow and insidious; in others rapid; in some cases there is no pain ‡; in others it is excruciating. The subjects of this disease are generally advanced in life; but the young occasionally become its victims: nor is this to be regarded as an ano-

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[*] Pott, loc. citato, p. 357.

[†] Vid. Hunter, loco super citato, p. 274.

[‡] Fabricius Hildanus de Gangraena et Sphacelo—Cap. VII.

maly, in the history of Gangrene; for the young may, from universal debility, become approximate to the condition of the aged; and when there is no part weaker than another, that will first die, which is most remote from the centre of nutrition. Of this we have the most apt illustration, in cases of Gangraena senilis cornea, produced by subsisting on diseased grain*. The diseased portions of grain play a negative part only, in the production of the disease—they very gradually deprive the body of nourishment, and thus induce universal debility.

The state of the mortified part forms a very striking peculiarity of this variety. It becomes hard and desiccated, very much resembling horn; and, being deprived of moisture, it cannot take on the putrefactive process.

Gangræna senilis ephemera.

5. I shall relate a case, from the Constitutio Epidemica Taurinensis of Carolus Richa, as an example of Gangraena senilis ephemera: Ju-

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[*] For a very ample account of the disease of grain, called by the French, Ergot, and its effects, when used as food, I refer to the memoirs of the Abbé Tessiers, Jour. de la soc. de med. Vol. I. and II.

"risconsultum juxta Theatinorum domum, qua "ad forum itur olitorium, febris a caena prehendit; noctem laboriosam transegit; postridie per totum pedem ad talum usque, tumor "subruber, ac tensus valde apparuit, cujus in "centro atrum quid aderat, at subnigrum. Insania correptus est, ex alvo merè biliosa plurima processere. Paulo post, convulsionibus a "capite subortis, celeri fato interiit. Ingenii "erat tetrici admodum, atroque vultu, absque "hominum consortio, omnino alienus ceu misanthrops alter."—I refer to Burserius[*] for a very accurately detailed case of this variety, in whose works, others similar will also be found recorded, from the writings of Hippocrates and Petrus a Castro. Cases have occurred in this city and its vicinity, which accord with the above, in their history and result.

The great incongruity between the violence of the constitutional symptoms, and the minuteness of the local disease, forms the prominent distinction of this variety. The rapidity with which the febrile attack runs into delirium, convulsions, and death, seems altogether inconsistent with the appearance of a small gangrenous spot, surrounded by diffused swelling and inflammation; but that other local injuries, of a nature very trivial, and from which we cannot deduce a rationale of the fatal issue, do cause death, is an incontrovertible fact. For example, an injury on the inferior and nasal portion of the orbit, (frequently inflicted in the harvest season by a wound from a pitch-fork), proves so suddenly fatal, that the sufferer has time left, only to lay himself down until he is overcome by death. I state the fact on the authority of Mr Abernethy; but I believe it is not limited to his experience.

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[*] Burserii Institut. Med. Practicae, § ccxx. De Ephemera Gangraenosa.

The age of the patient is not mentioned in the cases of Hippocrates, Petrus a Castro, and Richa;—in that so accurately detailed by Burserius, the patient was fifty-three years old. In three others, which have been mentioned to me, they were in an advanced period of life. In all, the toe and foot were affected, except that of a lady who was seized with a most excruciating pain over the internal angle of the eye. She imagined that it was a disease of that organ, and in order to have the advice of a London oculist, was repairing thither; but, before she had reached her destination, was attacked with violent constitutional symptoms; the eye-brow and fore-head became tumid and inflamed; in the centre of the inflamed part a small black spot presented itself; and she died, on the second day after the aggravation of the disease.

XII.

INFLAMMATION.

1. Inflammation is by far the most common cause of Gangrene. Of the phlegmonous and erysipelatous, the phlegmonous is that species of inflammation which produces the more dangerous cases of Gangrene,—the deep-seated parts, through a whole limb, mortifying in consequence of its violence. The erysipelatous, from its specific character, produces the more extensive cases of the disease, under the form peculiarly denominated Slough.

2. Inflammation more frequently produces Gangrene, when excited in one, than in another structure;—in the tendinous and cellular, for example, than in the muscular; and the ready production of Gangrene, in these structures, is, I apprehend, to be referred to different causes, which I shall afterwards have occasion to mention.

Inflammation is a cause operating so universally, that injuries, even from the slight bruise or scratch, to the most severe bruise or wound, may, according to the constitution of the patient, terminate in Gangrene. A slight bruise, accompanied by ecchymosis, may, by killing a portion of the skin, produce sloughing of that portion; and this I hold to be the most simple injury, accompanied with death of parts, in a constitution otherwise sound; but in those who are debilitated from any cause, the abrasion of a hair from the leg, or any other slight accident, is sufficient to induce inflammation, which will terminate in Gangrene.

3. Various accidents may be particularized, which also have this termination. Among these

we may mention fracture, simple or compound, —wounds in tendinous parts, especially when the wounding instrument conveys any irritating or poisonous matter,—and effusion of pus or urine in the cellular membrane.

4. Gangrene may be induced even by simple*, but it has always been dreaded as a consequence of severe compound fracture; and the apprehension of this consequence has, perhaps, more frequently than any other reason, induced the surgeon to have recourse to amputation.—The inflammation which is caused by the laceration of the soft parts, and is often kept up by the severed bone, the surfaces of which cannot be brought into contact, is frequently so violent as to produce Gangrene. But this is more certainly the consequence of that fracture, which affects tendinous parts; when it takes place, for example, near the ankle joint, or in the tibia, above the insertion of the tendons of the flexor muscles.

{Fracture.

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[*] Quesnay Traité de Gangrène, p. 129, 130.

Wounds in tendinous parts.

5. The celebrated Bichât, in the Traité de Membranès, has elucidated many obscure phenomena in physiology, and has afforded us an explanation of many practical facts. We are not yet informed respecting their ultimate cause. "Heu quantum est quod nescimus!"—But the anatomist who has arranged and classed the facts, ascertained regarding any subject, has paved the way for improvement.

Surgeons have long known, that wounds in tendinous parts are followed by violent inflammation; but Bichât has carried us a step farther—by proving that tendons are enveloped in sheaths of serous membrane, he has unfolded the mystery; and we recognise the similarity existing between the character of inflammation attacking this structure, and that which it assumes, in other serous membranes.

When inflammation attacks a serous membrane, it spreads rapidly, from continuous sympathy, over the whole of its surface. The fluid which is exhaled from this surface, and gives it a glistening appearance in the healthy state, is no longer poured out; and the structure which did not formerly communicate sensation, is now alive to the slightest impression.

When inflammation is produced in a tendinous structure, it rapidly spreads. When, for example, a finger is bruised or pricked, the metacarpus and carpus soon become involved, and the inflammation, which is accompanied with most excruciating pain, spreads up the arm with extreme violence;—abscesses are formed among the inflamed parts, which go on to suppuration; or the inflammation terminates in Gangrene. The inflammatory and suppurative stages of the injury, from the tension of the fasciae, binding down the inflamed parts, and confining the growing abscess, are also attended with acute pain, and violent symptomatic fever.

Absorption of unassimilated matter.

6. The effects of unassimilated matter on the constitution, have not received the full elucidation which they merit; but it is well known that wounds are followed by aggravated mischief, when the wounding instrument conveys unassimilated matter.

Extravasation of urine.

7. When urine becomes extravasated into the cellular membrane, which abounds in the neighbourhood of the urinary passages, it becomes widely diffused, and produces sloughing whereever it may have found its way. The cellular membrane dies sooner than the skin; but this, also, is soon affected with inflammation, assumes a dark purple colour, and at length sloughs off.

I apprehend that this effect must be attributed to the inflammation which urine excites.

Even the bland fluid of tears excites inflammation of the skin, although it does not irritate the lachrymal gland and ducts; and urine always excoriates the surface of the body, when suffered to pass over it. We cannot, therefore, be surprised that the cellular membrane is easily irritated by it, and more speedily dies, from the inflammation which it excited.

Effusion of pus.

8. Effusion of pus is followed by similar consequences with the effusion of urine. Erysipelatous suppuration most frequently produces this effect; for adhesion, to limit the diffusion of the matter, does not in this, as in phlegmon,

prevent the extension of disease; and a large portion of the cellular membrane and skin sloughs off. It is not easy to explain why the diffusion of pus should prove fatal to that part of the cellular tissue in which it occurs. Pus, in its perfect state, is a bland fluid, and, when confined, never irritates by its quality, although, from quantity, it often imparts irritation.

" Matter formed early in the state of suppu-" ration, either in abscesses, or, more especial-" ly, in consequence of any external violence " committed on the solids, has always in it a " portion of blood: or, if some parts of the " solids mortify and slough, these will mix with " the matter. The same thing happens when " the inflammation has something of the erysi-" pelatous disposition, so as to have produced " a mortification in the seat of the abscess. In " all such circumstances, we find that the pus " has a greater tendency to putrefy than the " pure or true pus, which comes to be discharged " afterwards in sound abscesses, or healing " sores: but, although the imperfect or hete-" rogeneous matter that is formed at first is " liable to putrefy when exposed, yet, if per-

"fectly confined in an abscess, it will remain a "considerable time without putrefaction. The "suppuration, however, in consequence of the "erysipelatous inflammation, which is often attended with suppuration produced by internal mortification, is, as we have observed, an "exception to this rule; for, although confined "from external air, yet the matter becomes "soon putrid, and this most probably arises "from the solids themselves first becoming "putrid*."

When sloughing is the consequence of an injury, we may attribute the death of the cellular membrane to the bruise; and the inflammation of the erysipelatous kind, to the irritation which the dead cellular membrane, and the effused blood create, in the surrounding parts.

XIII.

EXTERNAL VIOLENCE.

The very life and organization of a part may be destroyed by the impulse of a moving body, which case is well illustrated by the effect of gun-shot wounds. It were almost superfluous to remark, that External violence is the most common cause of inflammation, and often, thus indirectly, induces Gangrene.

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* Hunter, loco citato, p. 434.

XIV.

CALORIC.

1. Caloric is a most powerful stimulant to the animal body.

2. When the application is limited, it excites an increased action of the vessels of the part, followed by vesication; and the inflammation may become so violent, as to terminate in Gangrene.

3. When the heat is more violent, or longer continued, the fluids are evaporated; the organization of the solids is destroyed; and the part is converted into a mass of carbonaceous matter—to be thrown off like other dead substances. Superficial sloughs of this nature, often follow severe burns.

XV.

ABSTRACTION OF CALORIC.

1. In climates of high northern or southern latitudes, the inhabitants are, from accident or necessity, exposed to the inclemency of the season.

The extreme points of the body are deprived of their natural heat, and are then said to be *frost-bitten*.

2. The toes and foot, the fingers, the nose, and ears, are most liable to this accident; and the languid circulation of such parts, as well as their being more completely insulated, and surrounded by a frozen atmosphere, are reasons why they are liable to be frost-bitten.

3. When a part of a living body is frozen, the circulation is interrupted; sensation is abolished; the healthy colour of the part disappears, and it is, in every respect, dead. If it

has remained long deprived of its natural heat, upon being brought back to a temperature equal to that of the human body, the actions of life are not restored.

4. "Actio scilicet organica certo gradu sopita existit, motus cessat, sensus est abolitus, continua membri adest rigiditas, licet colorem non mutet, caro incisione facto nullum mittit sanguinem, quamvis tenerior et macerata videatur: et vita nihilominus in partem adeo labefactam revocari potest." *

If the part has not been so long exposed, as to have been completely deprived of life, when it is again thawed, it passes into a state of inflammation; and this inflammation may become so violent as to produce Gangrene.

5. In consequence of this accident, therefore, we have the parts in two different states; one portion already dead; another more or less inflamed. They are in the state of parts de-

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* Franck Delect. Opusc. Medic. Vol. V. p. 284.

scribed by Hunter, where one portion is killed, and another " so far hurt as to bring on " irritation, and not death *."

6. There is no peculiarity in the Gangrene of frost-bitten limbs. It is in such cases that we have the best view of the process of nature, in throwing off a dead part. We see the line of separation formed on the surface, and extending itself, by degrees, through the whole diameter of the limb.

XVI.

CURE.

1. Various means have been adopted to check the progress of Gangrene, and to restore the part to health.

2. The division into Internal remedies and Topical applications, corresponding with the two grand curative indications, to recruit the general health, and to promote healthy ac-

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* Hunter, loco citato, p. 256.

tion in the sound surface, is that which most readily suggests itself, for this department of the subject.

XVII.

CONSTITUTIONAL TREATMENT.

1. The cause of the disease must, of consequence, be held in view, toward the judicious employment of internal remedies.

2. As Gangrene is sometimes produced, and commonly accompanied, by general debility, the means which are employed to give tone to the system, are most extensively useful in its cure: But if it has arisen from an accident, in a constitution young and vigorous, the strength of the system is an adversary which we must combat, in order to moderate the inflammation, which in this case goes beyond the gentle degree, absolutely necessary to bring forth the healthy changes.

3. When Gangrene supervenes on inflammation excited in a vigorous constitution, by

compound fracture, by bruise, by frost, or other accident, to administer stimulant and tonic medicines, while the patient's health continues entire, would evince great ignorance of general principles. But even in cases of this nature, when the injury has been violent, and the disease extensive, the general health commonly fails before the local disease is cured; and stimulants and tonics will powerfully contribute, towards the completion of that object.

Wine. 4. When tonic remedies are not contraindicated, wine, given in divided doses, so as to keep up a gentle but uniform excitement, will promote the ulcerative absorption, by which the dead are to be separated from the living parts; and will induce that gentle degree of inflammation, in the conterminous sound surface, which is necessary for the production of healthy pus, and healthy granulations.

Bark. 5. Bark is usually combined with this inestimable medicine; and when first introduced into practice, was deemed equally specific against Gangrene, as against Intermittent fever. Unfortunately, however, it has not, in the history of the former, as in that of the latter disease, kept its high station; but has fallen from the title of specific, to that of an humble auxiliary.

Nevertheless, bark still enjoys a considerable share of reputation, in the cure of Gangrene, and from its tonic powers, I think it is a remedy of some virtue. Its operation, however, far from being of a specific nature, is referrible to the general properties of the class of medicines, to which it belongs. I conceive that its apparently wonderful efficacy is chiefly due to wine, the more potent medicine, in combination with which it is exhibited.

The influence of bark is exerted on the stomach, and through this organ, on the system in general; so that its effect, when it is exhibited simply, cannot be very sudden; and it is, therefore, considered singly, a remedy less calculated to check the progress of spreading Gangrene, than useful as a prophylactic. "I shall "frankly own," (says Sharp) "that I have ne-"ver clearly to my satisfaction met with evi-

" dent proofs of its preference to the cordial
" medicines usually prescribed *."

Bark, in moderate, and frequently-repeated doses, combined with wine, is the best preventive, and a useful auxiliary in every stage of Gangrene.

It is almost unnecessary to remark, that during active inflammation, it were unwise to give bark.

Opium.} 6. Opium is a remedy justly extolled, and of great virtue in Gangrene. In the more violent cases, while inflammatory action is in force, opium ought not to be employed; but when it has subsided, and pain deprives the patient of sleep, this narcotic, by affording "nature's "kind restorer," indirectly strengthens the system, and promotes a favourable and speedy issue. Disappointed of success in using bark, Mr Pott tried this remedy, which he has praised, as being of great efficacy in that variety of the disease, which I have denominated Gangræna senilis humida. He exhibited it in

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* *Vide* Sharp's Critical Enquiry.

substance, in the dose of a grain every three or four hours, "watching its narcotic effect, and "keeping the belly empty by glysters *."

From the principles established in the valuable Essay of Mr Crump, regarding the effects of opium, it is evident, that by the mode of its exhibition adopted by Mr Pott, he obtained a stimulant effect; for although a grain of opium is sedative to a man in health, yet a grain repeated every three or four hours, for nine days, becomes a stimulant; and in this manner it must prove a powerful remedy, in Gangræna Senilis.

When exhibited under such regulation as to procure a stimulant effect, it will always prove very efficacious in this species of Gangrene; and due attention to this principle will quiet our fears, and reconcile the opinion of Kirkland, with the experience of Pott and Franck. "I wish (writes Kirkland,) it could be said, "that the use of opium is as frequently followed with success in mortification of the "toes and feet; but it is impossible, as that

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* Pott's Works, vol. III. p. 361.

" disease is often incurable : Besides, although
" under regulation, I believe it to be a most
" powerful remedy in this disease ; yet it will
" sometimes increase it; nor is it always alone
" sufficient to accomplish a cure, which may
" be accomplished by the assistance of other
" remedies. *Its being given in large doses will*
" *frequently frustrate our intention* *."

Musk.

7. Musk, another medicine possessed of a stimulating property, has been found beneficial in mortification. Mr White of Manchester † derived great benefit from this remedy, exhibited in combination with the Volatile Alkali (which is also a powerful and very diffusible stimulus) in doses of ten grains of musk, and six of Volatile Alkali.

The rationale of its operations is the same as that of other stimulants ; and we are accordingly warned by Mr White, of the consequence of using it while inflammation is violent. It is worthy of remark, that musk was employed by that practitioner in five cases, of which, delirium had taken place in one, and subsultus in all; and that his patients recovered.

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* Kirkland on Amputation, &c. p. 61.

† White on Gangrene.

Carbonic Acid.

Carbonic acid has been given internally, with success, in Gangrene*. Carbonic acid is a powerful stimulus to the stomach, and by invigorating that organ, it will have great influence in recruiting the general system. Its power of recovering the lost tone of the stomach is best illustrated, by its influence on a man, who is recovering from a debauch—to him it restores a lost appetite, and removes the nausea and headach with which he is harassed. Although it may be less pernicious than alcohol, or any other strong stimulant, because its action is more particularly limited to the stomach, its effect, however, is more transient; and it cannot therefore serve the same purpose, in the professed debauchee.

Cathartics.

9. Gentle Cathartics may be resorted to with advantage, in those cases of Gangrene, in which the inflammation and fever are violent; and although it would be unwise to abstract blood, from a person in this situation, who would be

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[*] *Vide* Dobson on Fixed Air, p. 46.

much reduced before the disease could be removed, the more gentle means of abating the inflammation by cathartics, would be found of great benefit.

Laxatives.

10. The use of Laxatives is of high importance, in the treatment of Gangrene. The experience of ages has evinced the influence of a healthy and unhealthy state of the chylopoietic viscera, in warding off, or inducing, as well as in removing, or keeping up unhealthy actions in ulcers and other local diseases; and has evinced the reaction, which they reciprocally operate on each other. We are, therefore, aware of the importance, of attending to the state of these viscera, in the treatment of local diseases—to which point Mr Abernethy has, of late, particularly called the attention of surgeons *.

In every case of Gangrene, therefore, it becomes an object of the first moment, to give tone to the digestive organs, and to keep up in them that due action, which is equally neces-

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* Abernethy's Surgical Observations on the Constitutional Treatment of Local Diseases.

sary for the health of the various parts, as of the whole animal machine.

Mr Abernethy has particularly remarked, that a disordered state of the chylopoietic viscera occasionally produces erysipelatous inflammation and sloughing sores—which are cured by giving tone to these viscera, and thus removing an irritation, which kept up undue action in the diseased part *.

Brunninghausen and Dussaussoy have mentioned the good effects produced by small doses of the super-tartrate of potash; and Dessault has experienced great benefit from the use of emetics in Hospital Gangrene.

Richter speaks with much confidence of the efficacy of a gentle laxative, which he employed in a case of sphacelus in the arm, " A " mésure qûèlle (viz. la boisson de petit lait " et tamarins) lâchoit le ventre, le pouls se re- " levoit, il devint plein et souple, la Gangrène " se borna," &c. †

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* Abernethy, loco citat. p. 152,—176.

† Bibliotheque Germanique, vol. II. p. 258.

Besides the influence of eccoprotics on Gangrene, as a local affection, when it arises from debility, they, by their tonic effect on the stomach, the grand centre of nutrition, invigorate the system, and enable it to bring forth the changes, necessary for restoring soundness to the diseased part.

Bleeding.

11. Blood-letting is never to be recommended in the ordinary cases of Gangrene; as every circumstance indicates the necessity of an opposite mode of treatment. But Dr Trotter has proposed to employ it, in Contagious Gangrene, at the commencement of the inflammatory symptoms. "This seems to be the "period, which, if improved, will save the "patient incalculable torment; for the size "of the sloughs and the ulcerated surface "that follow, are in exact proportion to the "preceding inflammation and fever *:" and he gives a preference to local, over general blood-letting.

Regimen.

12. In some cases of Gangrene it may be proper to adhere to an antiphlogistic diet; but,

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* Trotter, Med. Naut. Vol. II.

in general, a regimen of an opposite character is necessary; and nourishing food, easily to be digested, must be liberally supplied to the patient.

XVIII.

LOCAL TREATMENT.

1. In the choice of topical applications, as in the exhibition of internal remedies, the cause of the disease, and state of the constitution and mortified part, must be carefully kept in view.

Simple Poultice.

2. When the disease is incipient, inflammation violent, and the patient's constitution vigorous, the simple poultice is the most proper application; and it proves soothing to the parts.

Evaporation.

3. Under similar circumstances, in Contagious Gangrene, Dr Trotter found great relief to accrue from the evaporation of cold water*,

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* Trotter, Med. Naut. vol. 2.

which is an excellent sedative of increased arterial action.

Stimulants.

4. But when the disease occurs in a weak constitution, or has, in its progress, rendered a strong constitution weak, while wine, bark, or other stimulants and tonics are exhibited internally, nature must be assisted in the work of separation, by stimulants applied topically: for which purpose the hot dressings, and other applications of a similar nature, have been occasionally made use of.

Yeast Poultice.

5. When the disease requires mild and soothing treatment, the fermenting may be substituted for the simple poultice. The yeast poultice may, by imparting a gentle stimulus, exert a beneficial influence on the living part.

Antiseptics.

6. Fixed air acts on the putrefactive fermentation, although not on its products *.

It may, therefore, be employed as an antiseptic, to prevent the effluvia from annoying

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* Dobson on Fixed Air, p. 46.

the patient or his attendants. Richter wrapped the diseased limb in waxcloths, and used vinegar *qua* antiseptic. How far such practice is necessary, to avert the danger which may arise from the influence of putrid matter, I will not presume to determine; but, as a measure of cleanliness and comfort, it may in some cases be adopted.

Escharotics.

7. Dr Rollo employed escharotics in Contagious Gangrene, with the intention of destroying the contagion, *in limine :* But this practice has been found injurious. To guard against its progress by contact, the greatest cleanliness must be observed; and its influence through the medium of the atmosphere must be obviated by ventilation, and the means employed by Smith and Morveau.

Treatment of a Frozen Part.

8. As in the treatment of burns and scalds, so in the treatment of a frost-bitten part, it is of great consequence not to remove it too rapidly, from that extreme intemperature which has produced the injury, to its opposite; and this practice, founded on experience and observation, is accordingly adopted by the inha-

bitants of those climates, in which such accidents most frequently occur.

When a part has suffered, from long exposure in a freezing atmosphere, instead of applying heat suddenly, as is naturally suggested, we must employ friction with snow, and afterwards with dry flannel, until the natural temperature is gradually re-established.

Scarification.

9. It is always unnecessary to have recourse to the knife, for the purpose of scarifying the mortified portion. On the dead part it can have no effect, and it is a rude method of stimulating the living.

Dilatation of Wounds.

10. Mr Kirkland, reasoning from the success which attended Dr Bilguer's practice in compound fracture,* recommended free and timely openings, which cleanse the wound, and prevent mortification.†

To give egress to the discharge from a wound of this nature, which, containing blood and foreign matter, is apt to become putrid, and thus to excite inflammation and sloughing, is apparently good practice; but I confess myself unfit justly to appreciate it; and I hesitate to decide, how far it may be advisable to irritate such a wound by the knife.

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* This was the practice of surgeons from a period much anterior to the age of Bilguer.

† *Vide* Kirkland, p. 21.

Amputation.

11. Amputation, although not (strictly speaking) a remedy for Gangrene, yet, as a means of averting it, or of preventing its bad consequences, may be introduced under the head of topical treatment. It has always been esteemed a point of weighty consideration, to define the cases in which amputation shall with propriety be employed, and that period in the history of the disease, at which it ought to be resorted to.

Compound fracture is the accident which most frequently threatens to induce Gangrene, and such will most probably be its consequence, if the laceration is very great, and the accident has occurred to an aged person, or in tendinous parts. Amputation ought, under such circumstances, to be immediately recommended, that "by converting fracture with laceration of soft parts into a simple wound," we may remove all apprehension of Gangrene, which would, in the aged, most probably prove a fatal consequence.

When Gangrene takes place, amputation, as has long been familiarly known, is an inefficacious and dangerous expedient; for if it is performed, the arteries do not pour out blood, being filled with a coagulum so firm that it cannot be washed away by a spunge *; circulation is completely interrupted; and the blood-vessels cannot be secured.

It is obvious, that we cannot ensure circulation in the stump, by amputating at a determinate distance above the disease; for the coagulum, as already stated, has been found to extend to the iliac artery; and it is equally obvious, that without circulation, the stump cannot take on the healing process. These I conceive to be the reasons, why amputation is inadmissible in gangrened limbs, while the dis-

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* *Vide* O'Halloran on Gangrene, p. 14.

ease is recent. But I may add, that Mr Pott, in cautioning against amputation, has told us how irregularly the disease extends in the soft parts *; and Richter mentions, that in one case, the loss of parts was so much greater on the anterior, than on the posterior surface of an arm, that he employed the muscular substance left on the posterior part to cover, like a flap, the bare stump †. Sharp also cautions against amputating in gangrened limbs, as we know not where the disease may stop, and it might, therefore, appear, *de novo*, on the stump ‡.

Although Gangrene, while undefined, cannot with safety be removed by amputation, yet this operation, when resorted to at the proper period, may save the patient's life. We must, however, always wait to see the line of demarcation drawn, and pause, until it has penetrated even to a considerable depth, between the living and dead parts. O'Halloran operated in one case, after the line of separation had shown itself, and made his first incision four inches above that line; but circulation was not there, even then, re-established, and the result was fatal.

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* Pott's Works, Vol. III.

† Bibliotheque Germanique, Vol. III.

‡ Sharp's Critical Enquiry.

When we have reason to fear, that the patient's constitution is incapable of effecting a cure, by the natural process, amputation is the only means which can give a chance of recovery; and it ought without hesitation to be put in practice: but from what I have witnessed, in cases where both feet were thrown off by the ankle-joint, and the patient was cured by the natural process, I feel disposed, though not with blind confidence, to trust much to the course of nature.

FINIS.

Murray & Cochrane,
Printers, Edinburgh.